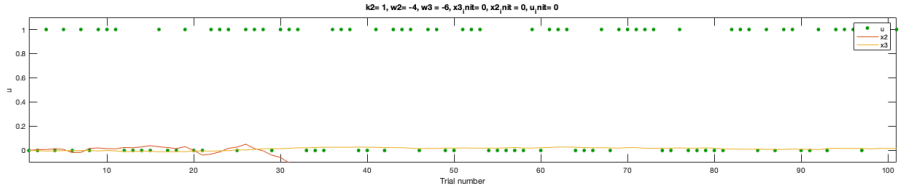
Table of Contents

b) Generating the inputs with the generative model for the three level HGF 1
Trying out different thetas 1
c) Simulating beliefs and responses 5
d) 7

b) Generating the inputs with the generative model for the three level HGF

```
k2 = 1;
w2 = -4;
w3 = -6;
x3_init = 0;
x2_init = 0;
u_init = 0;
inputs = generate_inputs(k2,w2,w3,x3_init,x2_init,u_init);
u = inputs(:,1);
x2 = inputs(:,2);
x3 = inputs(:,3);
scrsz = get(0,'ScreenSize');
outerpos = [0.2*scrsz(3),0.7*scrsz(4),0.8*scrsz(3),0.3*scrsz(4)];
figure('OuterPosition', outerpos)
plot(u, '.', 'Color', [0 0.6 0], 'MarkerSize', 11)
xlabel('Trial number')
ylabel('u')
axis([1, length(inputs), -0.1, 1.1])
hold on;
plot(x2);
plot(x3);
legend('u','x2','x3')
str = sprintf('k2= %0.5g, w2= %0.5g, w3 = %0.5g, x3_init= %0.5g,
 x2_init = %0.5g, u_init= %0.5g', k2,w2,w3,x3_init,x2_init,u_init);
title(str)
hold off;
```

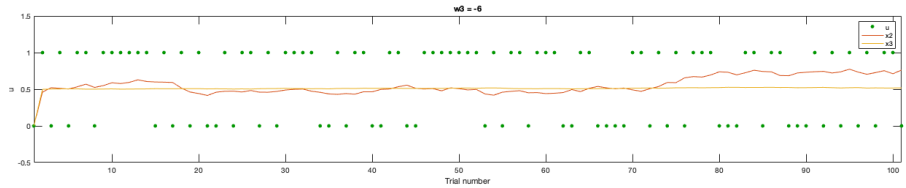


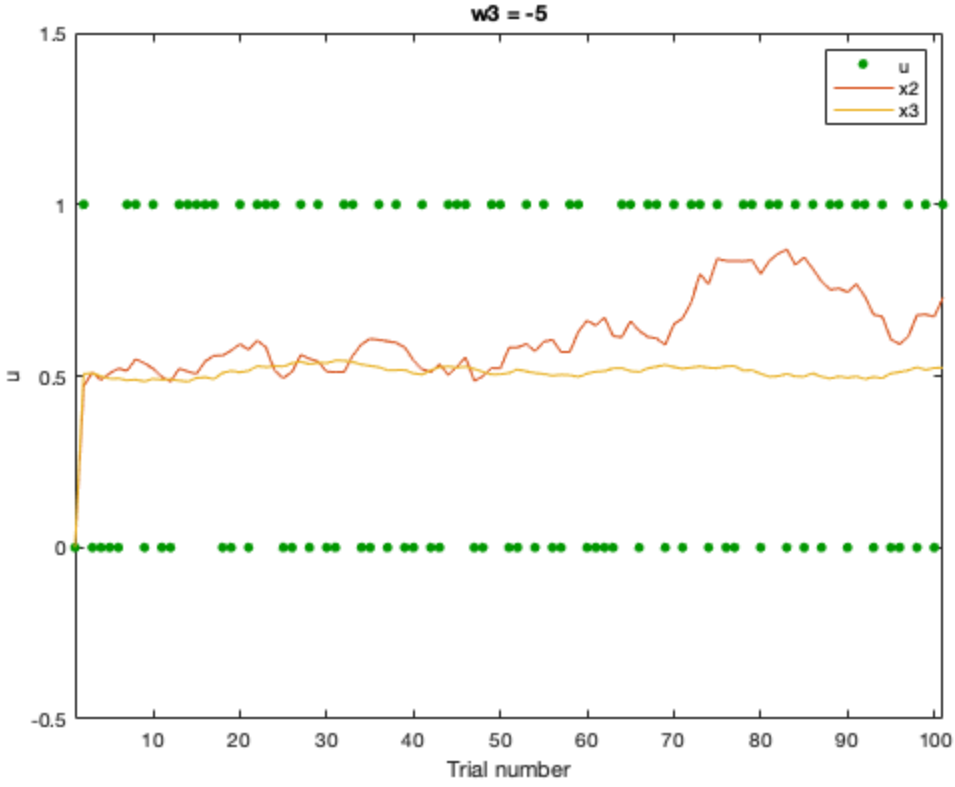
Trying out different thetas

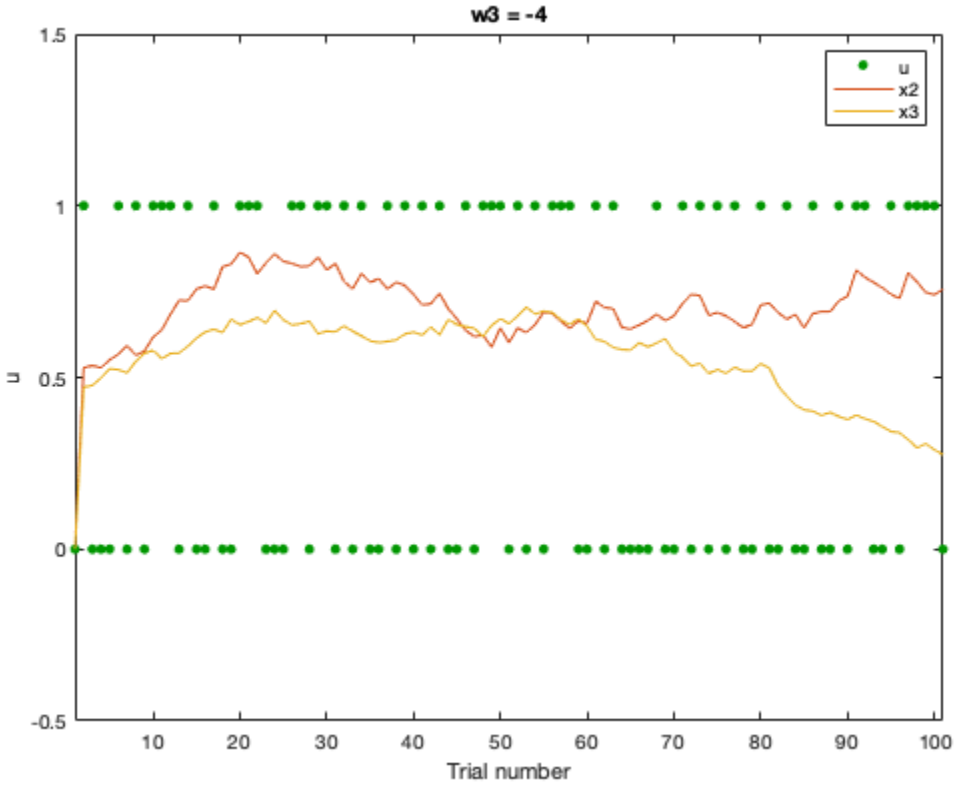
Higher volatility coefficients make the generated x2 and x3 much more variant. If it is too low, x2 (the tendency towards 1) becomes constant

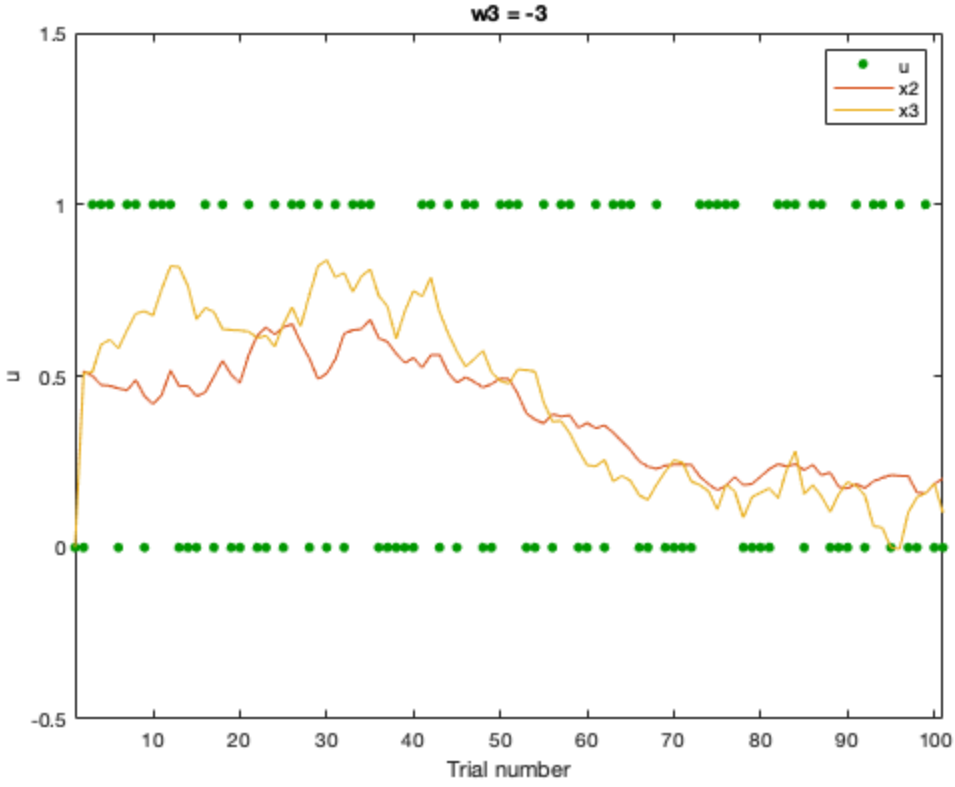
```
k2 = 1;
```

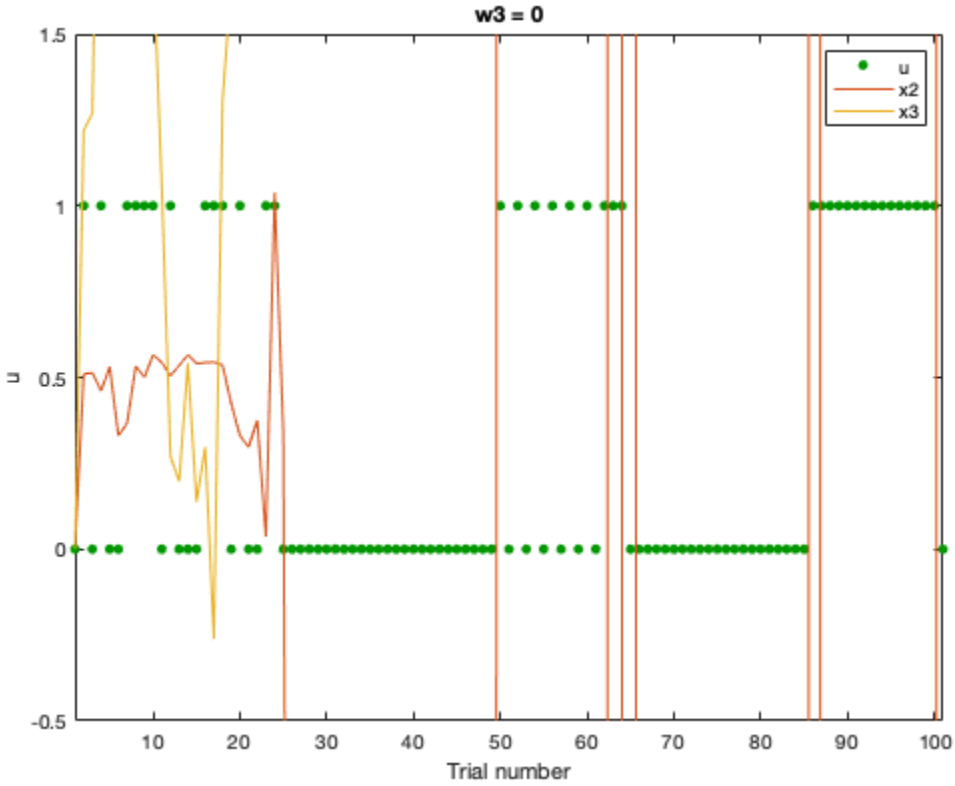
```
w2 = -4;
w3_list = [-6, -5, -4, -3, 0, 1];
x3_init = 0.5;
x2_init = 0.5;
u_init = 0;
it = 1;
for w3 = w3_list
inputs = generate_inputs(k2,w2,w3,x3_init,x2_init,u_init);
u = inputs(:,1);
x2 = inputs(:,2);
x3 = inputs(:,3);
figure(it)
plot(u, '.', 'Color', [0 0.6 0], 'MarkerSize', 11)
xlabel('Trial number')
ylabel('u')
axis([1, length(inputs), -0.5, 1.5])
hold on;
plot(x2);
plot(x3);
legend('u','x2','x3')
str = sprintf('w3 = %d', w3);
title(str)
hold off;
it = it + 1;
end
```

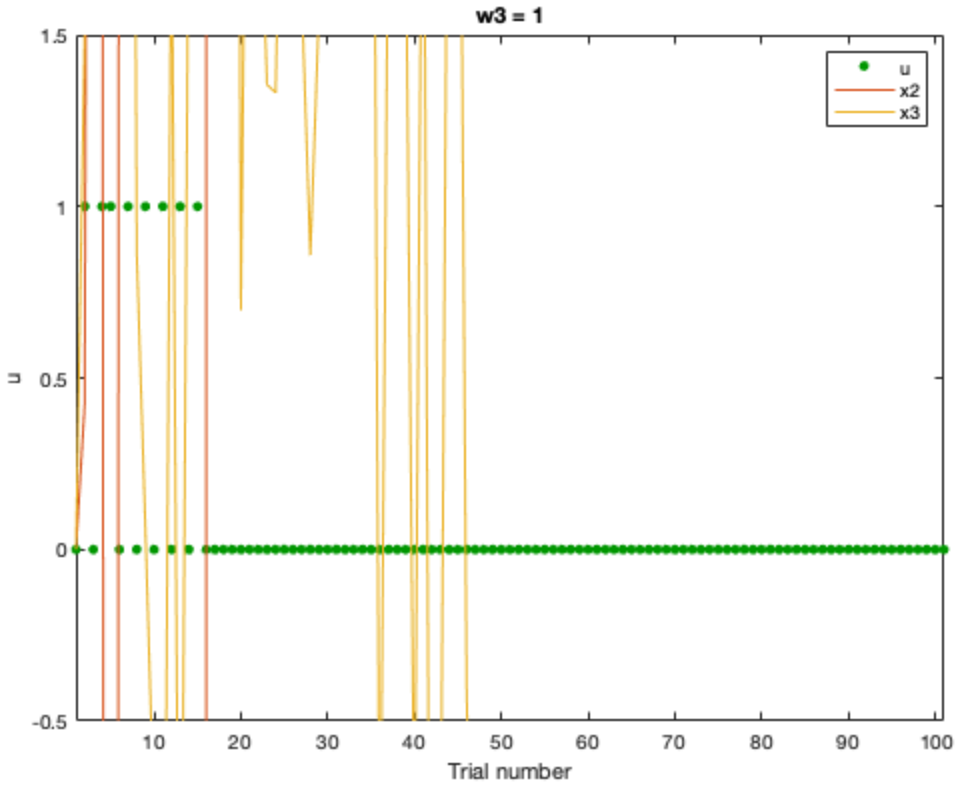



w3 = -5
u
x2
x3
1.5
1
0.5
0
-0.5
u
10
20
30
40
50
60
70
80
90
100
Trial number


w3 = -4
u
x2
x3
1.5
1
0.5
0
-0.5
u
10
20
30
40
50
60
70
80
90
100
Trial number


w3 = -3
u
x2
x3
1.5
1
0.5
0
-0.5
u
10
20
30
40
50
60
70
80
90
100
Trial number


w3 = 0
u
x2
x3
1.5
1
0.5
0
-0.5
u
10
20
30
40
50
60
70
80
90
100
Trial number

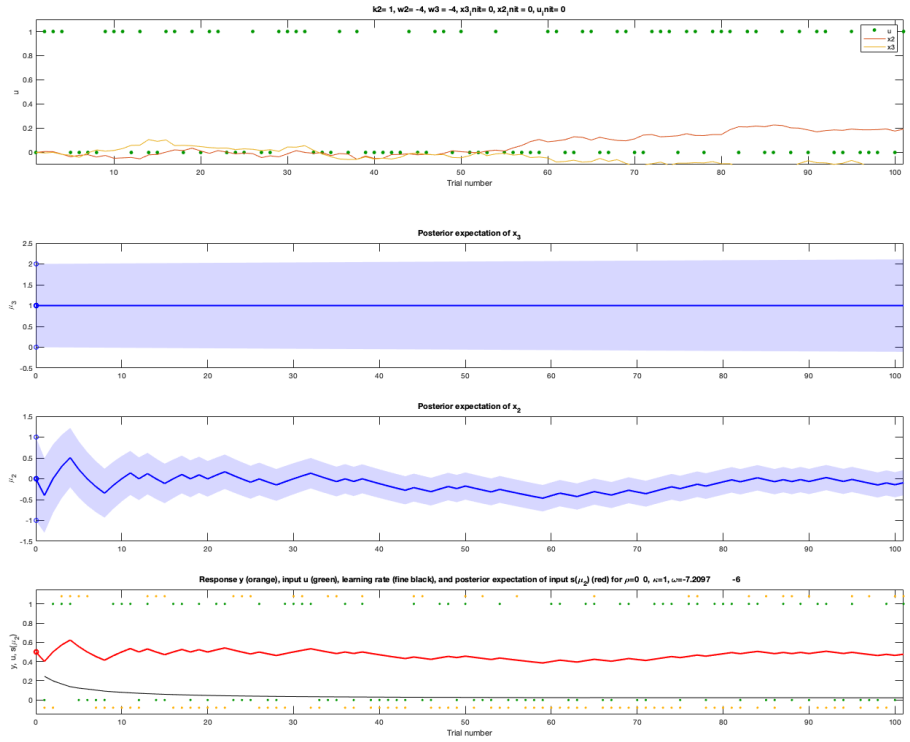


c) Simulating beliefs and responses

```
%The estimates for w2 and w3 (-7.2097, -6.0000) are far of the
 original values (-4, -4).
%The simulated agent does not track well x3 (which is estimated
 constant at 1 but is in fact variant around 0), nor x2. In our
 simulation x2 varies between 0 and 0.2 while the agent estimates the
 x2 between -0.5 and 0.5.

addpath('../tapas/HGF')
k2 = 1;
w2 = -4;
w3 = -4;
x3_init = 0;
x2_init = 0;
u_init = 0;
inputs = generate_inputs(k2,w2,w3,x3_init,x2_init,u_init);
u = inputs(:,1);
x2 = inputs(:,2);
x3 = inputs(:,3);

scrsz = get(0,'ScreenSize');
outerpos = [0.2*scrsz(3),0.7*scrsz(4),0.8*scrsz(3),0.3*scrsz(4)];
figure('OuterPosition', outerpos)
plot(u, '.', 'Color', [0 0.6 0], 'MarkerSize', 11)
```

```
xlabel('Trial number')
ylabel('u')
axis([1, length(inputs), -0.1, 1.1])
hold on;
plot(x2);
plot(x3);
legend('u','x2','x3')
str = sprintf('k2= %0.5g, w2= %0.5g, w3 = %0.5g, x3_init= %0.5g,
 x2_init = %0.5g, u_init= %0.5g', k2,w2,w3,x3_init,x2_init,u_init);
title(str)
hold off;

est = tapas_fitModel([],...
                         u,...
                         'tapas_hgf_binary_config',...
                         'tapas_bayes_optimal_binary_config',...
                         'tapas_quasinewton_optim_config');
sim = tapas_simModel(u,...
                     'tapas_hgf_binary',...
                     [NaN 0 1 NaN 1 1 NaN 0 0 1 1 NaN
 est.optim.final(13) est.optim.final(14)],...
                     'tapas_unitsq_sgm',...
                     5,...
                     12345);

tapas_hgf_binary_plotTraj(sim)
```

```
Ignored trials: none
Irregular trials: none

Optimizing...

Calculating the log-model evidence (LME)...

Results:

Parameter estimates for the perceptual model:
    mu_0: [NaN 0 1]
    sa_0: [NaN 0.1000 1]
     rho: [NaN 0 0]
      ka: [1 1]
      om: [NaN -7.2097 -6.0000]

Model quality:
    LME (more is better): -72.0156
    AIC (less is better): 145.609
    BIC (less is better): 150.8393

    AIC and BIC are approximations to -2*LME = 144.0313.

Ignored trials: none
```



d)

```
%In general it doesn't seem like a good idea to use the generative
 model of
%the HGF to generate stimulus sequences, because as an experimenter
%depending on what one wants to show, one would use a specific
 sequence of
%stimuli. It is nevertheless a useful model for the agent to invert
 during
%perception because of the different tunable parameters that can be
%estimated.

close all
```

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